

Effectiveness Monitoring of Tidal Restoration Projects

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The stakes are high for restoration in Suisun Marsh due to limited sites, costs, and ecological uncertainties. The State and Federal Contractors Water Agency's (SFCWA) Tule Red Tidal Restoration Project will restore 420 acres of tidal wetlands to meet OCAP Biological Opinion requirements. The Adaptive Management and Monitoring Plan (AMMP) is an objective-based framework designed to meet multiple purposes: verify permit compliance, document habitat credits, measure effectiveness/progress toward objectives, reduce key uncertainties, detect triggers for management, and improve overall restoration practices. Effectiveness monitoring focused on metrics linked to objectives: food web enhancement for delta smelt/longfin smelt, rearing for juvenile salmonids, brackish aquatic-tidal marsh-upland habitat for native species, and elevation gradients for habitat succession. We framed hypotheses about channel inlet and tidal regime, elevations and hydrology related to *Phragmites* colonization, vegetation establishment on the habitat berm, and residence time and productivity in the marsh ponds and pannes. Physical outputs (acres, topography, tidal inundation) and habitat structure (wetland vegetation) will be easier to measure than ecological outcomes (food web productivity and export, habitat use by fish). Fish sampling cannot be conducted without permits. Special studies are recommended for uncertainties (methyl mercury, nutrient flux) that require greater expertise and investment than basic monitoring. Metrics and methodologies were informed by regional IEP methods and other projects. The AMMP included triggers and responses for selected management issues, such as invasive weeds, obstruction of the channel inlet, low dissolved oxygen in discharge. Identifying roles and responsibilities between the property owners (SFCWA, then CDFW) and regional sampling and studies (UC Davis, DWR, IEP) can identify gaps and help ensure coordinated sampling. This AMMP is relevant for Delta restoration as a template for monitoring and adaptive management. As more projects come online, it will be important to coordinate monitoring and studies to maximize opportunities for learning and efficiency.

Keywords: Monitoring Plan Wetlands Food Web Fish Permit Requirement Aquatic

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Designing Tidal Restoration Projects for Physical Processes

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Tidal restoration design focuses on restoring natural processes vital for healthy and sustainable marsh habitats while balancing other regulatory and constructability design constraints. Tidal exchange is the driving process that creates and sustains tidal wetlands. Key elements of tidal exchange include inundation, sedimentation processes, and exchange of nutrients. Restoring the tidal exchange process promotes growth of marsh vegetation, allowing food web and ecological processes to occur. Elements which may inhibit these processes from occurring include undersized channels which mute tidal exchange, poor channel layout limiting sediment delivery and nutrient exchange to the entire marsh, invasive marsh vegetation which inhibits natural channel development, lack of suspended sediments, and other factors. The restoration design must understand these constraints and address them during the design. Functional design components required to satisfy species specific project objectives or regulatory requirements can then be incorporated into the design around the process based design components. Constructed channels and project features must be significant enough to restart natural processes, but limited enough to avoid unnecessary project impacts and be constructible. This presentation provides a case study discussing the design process of the Tule Red Tidal Restoration Site in Grizzly Bay. The approximate 400-acre managed marsh is composed of recently deposited sediments with dense stands of *Phragmites*. The proposed project includes excavation of over 7.5 miles of marsh channels reconnecting the marsh to Grizzly Bay including low order channels to enhance marsh connectivity and geomorphic progression. Functional design concepts were included to address objectives in the Suisun Marsh Plan as well as meet species specific design objectives. The design is currently being implemented.

Keywords: Tidal Restoration, Hydraulic Channel Morphology, Sea Level Rise, Shear Stress

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Tidal Restoration in the Suisun Marsh and Conflicting Regulatory Requirements and Permits

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Problem Statement: A large number of regulatory agency approvals are needed for tidal restoration projects in the Suisun Marsh, and each agency has legal and policy requirements that often put those requirements in conflict with other agencies. Resolving these often unanticipated conflicts adds time to project approval and takes careful negotiation. Resulting long timelines for permit approval of tidal restoration projects increases cost and uncertainty when initiating projects for development.

Approach: The Tule Red Tidal Restoration Project began its planning and design phase in 2012 with a suite of resource agencies. Sufficient basis of design detail was developed by the spring of 2015 to initiate environmental review and permitting. Careful study of existing permits and approvals for other relevant projects provided a baseline of potential permit conditions. Early consultation with agencies will also give project proponents information on permit requirements, relevant interdependencies of other approvals, and timelines for approvals.

Results: Once permit applications and environmental documents were submitted, several conflicting requirements became apparent. Requirements for creation of a “habitat levee” to provide transitional habitat between wetlands and uplands for salt marsh harvest mouse converted wetlands to uplands, putting the project in conflict with California’s no-net-loss wetland policy. One agency’s guidance requires development of maximum feasible public access under any permit given for a shoreline project which is in conflict with the conservation easement required by a different agency.

Conclusion/Relevance: Within the Suisun Marsh and elsewhere in the Delta, tidal restoration projects would benefit from programmatic solutions to resource conflicts like the ones experienced in development of this project. Creating a “Regional Permit” that would apply to all tidal restoration projects meeting the goals of the Suisun Marsh Plan would be an economical and time-saving alternative to project-by-project permitting, often costing hundreds of thousands of dollars per project.

Keywords: Suisun Marsh Tidal Restoration Salt Marsh Harvest Mouse Permitting

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Problems and Promise of Restoring Tidal Marsh to Benefit Native Fishes in the North Delta during Drought and Flood

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Implementing aquatic restoration projects that scale appropriately with seasonal flows, tidal energy, and food production remains a challenge in the highly disturbed Sacramento-San Joaquin Delta and Suisun Bay. Many restoration projects may achieve aesthetically pleasing results that will offer some benefits to recreationists, terrestrial animals and plants, without improving aquatic habitat for native fishes. Much of the disparity in benefits derives from the limited access that aquatic organisms have to the terrestrial environment. However, the historical Delta had a landscape that was much more integrated than today. Extensive wetlands merged with riparian corridors and shallow water habitats. Unfortunately, wetland restoration is unlikely to resume historical functions without structural modifications to increase integration between habitats. In addition, the elevation and structure of restoration sites must be calibrated to match tidal or flow action. Such restorations may feature mixed residence times of water and plankton, dendritic shallow channel networks that provide limited access during certain tides, and dispersed predation and foraging opportunities. I will examine a few existing and proposed restoration sites, evaluate their design, and determine how well they will support the stated aims or the project, and provide alternatives or design modifications that could improve function. Finally, I will discuss how configurable restoration projects can help build credibility in restoration success and support the implementation of adaptive management to hone desirable outcomes.

Keywords: restoration, tidal marsh, native fishes, landscapes, historical Delta, food production

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Tidal Restoration in the Suisun Marsh and Mitigating the Impacts to Waterfowl

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Problem Statement: The Suisun Marsh (Marsh) has long been recognized for its importance to waterfowl throughout the Pacific Flyway. In 1974, the Legislature passed the Suisun Marsh Preservation Act which declared the need for the preservation of waterfowl carrying capacity in the Marsh. In general, tidal restoration in the Marsh will result in the loss of high quality waterfowl habitat. The Suisun Marsh Plan proposes to mitigate the impacts from tidal restoration on waterfowl by improving the carrying capacity of the remaining waterfowl habitat (as much as 45,000 acres of habitat enhancement). However, there is only limited data on what different waterfowl species eat during the winter and how they use habitats in the Marsh, so what habitat enhancement means in practice remains equivocal.

Approach: The Suisun Marsh Waterfowl and Managed Wetlands Research Program was established in 2014 to understand waterfowl habitat use and foraging ecology in the Marsh. We have begun implementation of a multi-year gps telemetry study on up to 13 species of wintering waterfowl and 2 species of breeding waterfowl that use the Marsh and San Francisco Bay Estuary.

Results: We have deployed more than 100 gps transmitters on a total of 7 species of waterfowl. To date, more than 600,000 data points have been collected.

Conclusion/Relevance: Since the 1974 Suisun Marsh Preservation Act, 4 species of wintering waterfowl have shown significant population declines in the Marsh, Northern Pintail (83%), Cinnamon Teal (82%), Mallard (68%), and Scaup (24 %). Our work demonstrates the many complexities surrounding developing appropriate waterfowl habitat enhancement including the need to understand factors limiting breeding waterfowl in the Marsh, factors limiting waterfowl populations during migration or on breeding grounds outside of California, as well as, the need to understand specific foods important to breeding and wintering waterfowl in the Marsh.

Keywords: Suisun Marsh, Adaptive Management, Waterfowl, Tidal Restoration, Radio Telemetry

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